

WETBUD PLUS PROJECT WIZARD

USER'S MANUAL

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Introduction

Wetbud is a tool for estimating wetland water budgets using available weather data and site-specific topographic, soil, and geohydrologic data. Wetbud has been developed in two versions, a Basic 2-D formulation with simplified groundwater functions and the Advanced 3-D version with full groundwater modeling capabilities. Wetbud is primarily intended as a planning tool for use in the design of created wetlands, but it can also be applied to native wetlands where the required input parameters can be specified.

Wetbud Plus is an enhanced version of the Basic formulation of Wetbud that features a preloadable database from 14 selected Virginia weather stations. A polygonal influence area has been defined for each of the preloaded weather stations. Preloaded weather data include precipitation, weather information, and calculated evapotranspiration (ET) values using either the Penman-Monteith method or the Thornthwaite equation, depending on data availability. A Project Wizard allows users to quickly set up Projects and Scenarios (see next section) using default parameters and to calculate water budgets using the basic model.

Projects and Scenarios

In Wetbud, the *Project* designates site-specific characteristics that are determined by the location of the site and will be held constant during different design iterations (e.g. name, latitude and longitude, elevation, reference weather station, wetland watershed characteristics, etc.). Once a Project is created, the user can create one or many *Basic Scenarios* for the Project. The following notes explain the steps users should follow to operate the Wetbud Setup Wizard to create a new Project and then a Basic Scenario within that Project.

Data Required to Create a Project and a Scenario

Before constructing a Basic Model with the Wetbud Project Wizard, the user should have collected the following information and data:

- **Project name** (up to 20 characters).
- **Latitude and longitude** of a central point within the study area, in decimal degrees. These values are used to select the appropriate reference weather station.
- **Wetland surface elevation**, in feet. (This value should be obtained from a topo map or actual survey data.)
- Constructed wetland area, in acres.
- **Wetland watershed area**, in acres. (Boundaries for these areas can be drawn using Google Earth Pro based on USGS topo maps available in Google Earth format. These measured areas can be determined by using Google Earth Plus and an on-line area conversion site.)
- **Wetland Watershed NRCS Curve Number (CN)**. This ranges from 40-100, with a default of 70. The CN needed is the area-weighted value based on Hydrologic Soil Group (HSG) classes and land use for the watershed. The proportion of the watershed with each HSG class can be obtained most easily from NRCS Web Soil Survey; Google Earth images may be useful in assessing land use. CN values for each HSG and land use can be obtained from on-line tables. To get the single CN for the watershed, the CN values for each HSG must be multiplied by the proportion of the basin with that HSG classification; those weighted values must be totalled.

Project Wizard Assumptions

When creating a Scenario, the Project Wizard assumes water inputs from precipitation, runoff from adjacent slopes, and an assumed initial fill depth of 2.00 inches. Water is assumed to be lost through evapotranspiration, groundwater seepage (@ 1 inch/month), and surface outflow when water depths overtop the designated weir elevation. The default water management assumes a weir height of 3.00 inches above the flat wetland soil surface, a soil storage factor of 0.2, and a surface storage factor of 1.

Once the Project and first Scenario are established within the Wizard and the first calculations are made, the user may add more inputs (e.g. stream bank overflow and groundwater seepage) and may adjust any of the default values if/as necessary to better match anticipated field conditions.

Operating the Project Wizard

The screenshot in Figure 1 is what the user will see when the Wetbud program is opened. In the status line at the bottom of the home screen, the version number, the currently selected Project, and the Wetbud database location are identified.

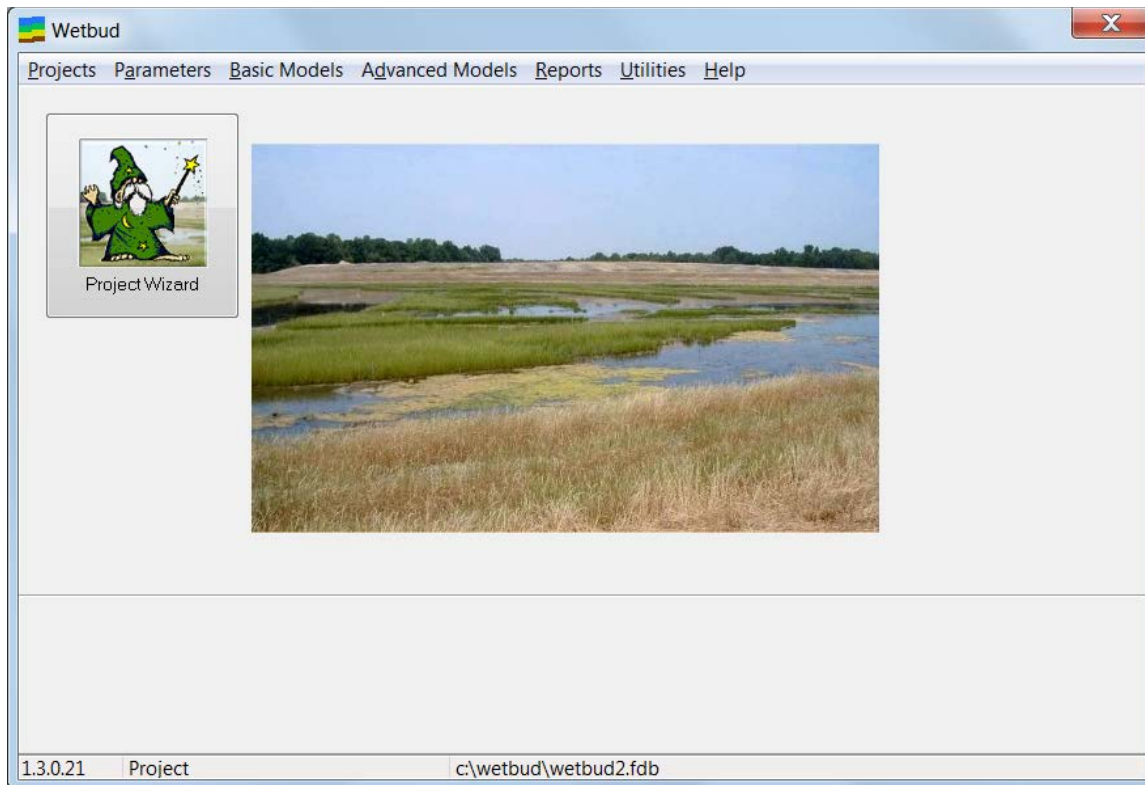


Figure 1. Wetbud Home Screen.

From the Wetbud Home Screen, select the Wizard icon to run the *Project Wizard*. The disclaimer message will appear (Figure 2). Select to proceed.

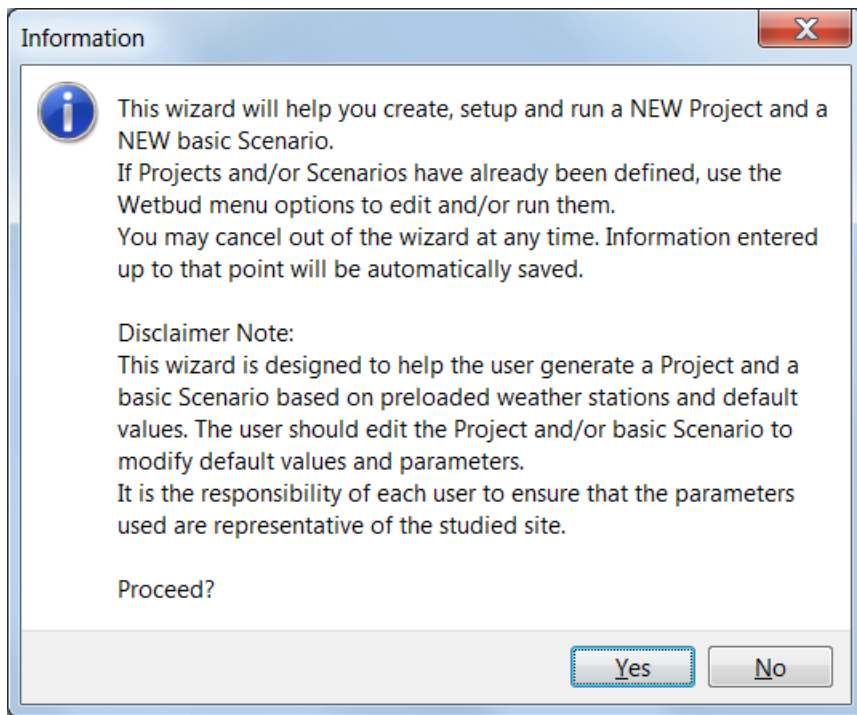



Figure 2. Wetbud Project Wizard Disclaimer.

To define an new Project, select “*Define A New Project*”, and enter the Project name, latitude and longitude in decimal degrees (e.g. 37.349), and elevation in feet (Figure 3), then select .

A "Project Setup Wizard" dialog box with a "Projects" tab and a "Debug" tab. Under "Select Project Option", there are two radio buttons: "Define a new Project" (selected) and "Use an existing Project". To the right, there are four text input fields: "Enter the Name for the New Project" (containing "New Project"), "Enter Project Latitude (decimal)" (containing "37.349"), "Enter Project Longitude (decimal)" (containing "-77.5836"), and "Enter Project Elevation (ft)" (containing "205"). At the bottom right, there are "Next" and "Exit" buttons.

Figure 3. Wetbud Project Wizard: Defining a new Project.

The message in Figure 4 will appear. Select  to proceed.

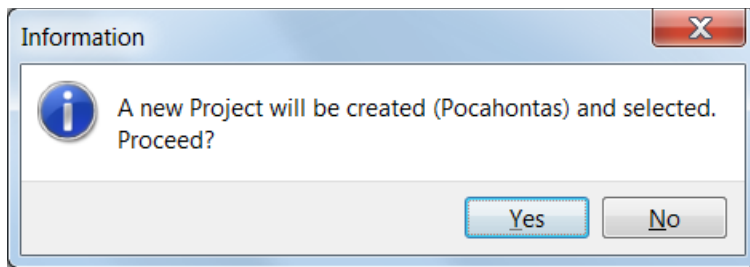



Figure 4. Wetbud Project Wizard: Creating a new Project.

To use an existing Project, select “*Use an existing Project*”, highlight the Project that you want to use, and select  (Figure 5).

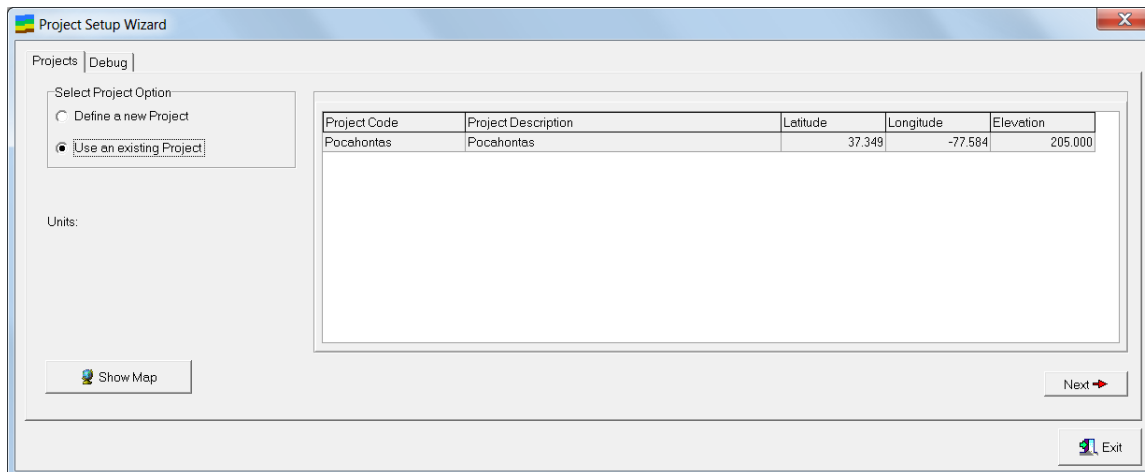


Figure 5. Wetbud Project Wizard: Using an existing Project.

The message in Figure 6 will appear. Select  to proceed.

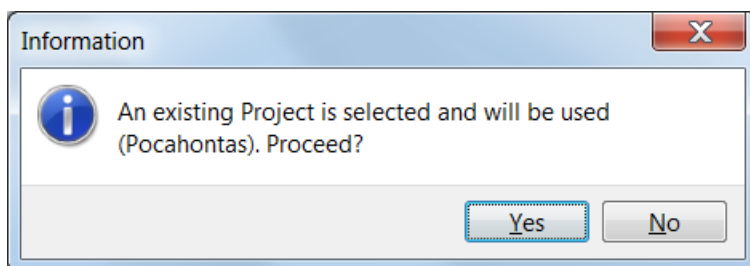


Figure 6. Wetbud Project Wizard: Selecting an existing Project.

After creating a new Project or selecting an existing Project, the weather station selection screen will appear. Weather stations are filtered based on the entered latitude and longitude of the Project and the following four options (Figure 7) will appear:

1. *Radius of Influence (All)* will display all weather stations that are within the selected range of miles from the Project (wetland) location as determined by its latitude and longitude.
2. *Radius of Influence (Preloaded)* will display only the preloaded weather stations within the selected range of miles from the Project (wetland) location.
3. *Polygon (All)* will display all the weather stations whose polygonal area of influence includes the Project (wetland) location as determined by its latitude and longitude.
4. *Polygon (Preloaded)*, which is the default, will select all the preloaded weather stations in the polygonal area of influence that includes the Project location.

Note: The weather station selection options marked **Preloaded** apply *only* to Wetbud Plus. If there are no preloaded stations covering the area of interest to the user, then no weather stations will be displayed under that option.

To use the default [*Polygon (Preloaded)*] station, click on it and select



(Figure 7). When the Polygon (Preloaded) option is selected, Wetbud will either display one station if the Project location falls within a predefined polygon, or no stations at all.

Project Setup Wizard

Weather Stations

Weather Station Selection Option

- ☐ Radius of Influence (All)
- ☐ Radius of Influence (Preloaded)
- ☐ Polygon (All)
- ☒ Polygon (Preloaded)

Radius Range Option

- ☐ within 10 miles
- ☐ within 20 miles
- ☐ within 30 miles
- ☐ within 40 miles
- ☐ within 50 miles
- ☐ within 60 miles
- ☐ within 70 miles
- ☐ within 100 miles

Station Co	WBAF	Location	St	Latitude	Longitude	Elevation	Dry Y	Norm	Wet Y	Preci	Penn	Thon	Preci	Penn	Thon	Preci	Penn	Thon
724010	13740	RICHMOND INTER	VA	37.50	-77.32	50.00	1995	1990	1984	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Show Map

Previous Next

Exit

Figure 7. Wetbud Project Wizard: Selecting a Polygon (Preloaded) weather station.

Wetbud will then tell you what type of ET values are available for the default Wet, Normal, and Dry years at that station, as shown in Figure 8. When Penman ET values are not available for a preloaded station due to missing solar data, then Thornthwaite ET values will be provided. This information is available in the Wetbud Plus database for the 14 preloaded VA stations. Select to proceed.


Note: If a non-preloaded weather station is used, then the user should make sure that ET values are available for that station.

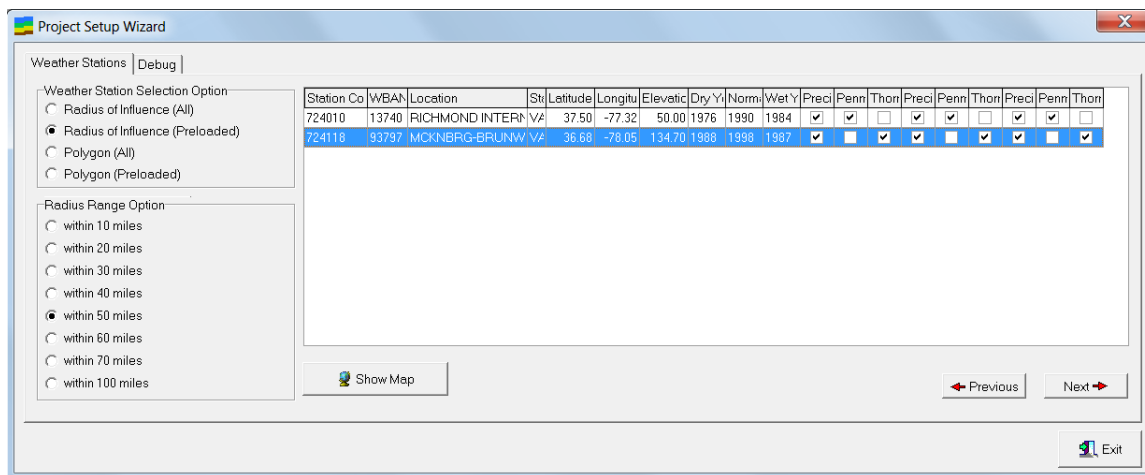
Information

Based on the available data, only Penman ET values are available for the default Wet, Normal or Dry years. Proceed with selecting the current weather station?

Yes No

Figure 8. Wetbud Project Wizard: ET value notification.

To use the *Radius of Influence (Preloaded)* option, click on it, choose the desired mileage range, highlight your preferred weather station and select  (Figure 9). More than one weather station may fulfill the radius of influence criterion, so the user should select a specific station.



Station Co	WBAN	Location	St	Latitude	Longitude	Elevation	Dry Yr	Norm	Wet Yr	Preci	Penn	Thorn	Preci	Penn	Thorn	Preci	Penn	Thorn
724010	13740	RICHMOND INTER	VA	37.50	-77.32	50.00	1976	1990	1984	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
724118	93797	MCKNBRG-BRUNW	VA	36.68	-78.05	134.70	1988	1998	1987	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Figure 9. Wetbud Project Wizard: Selecting a *Radius of Influence (Preloaded)* weather station.

In this following example, the *Polygon (Preloaded)* weather station will be used. After weather station selection, the screen in Figure 10 will appear. To define a new Scenario, choose “*Define a new Scenario*”, and enter:

- the Scenario Code
- the area of the constructed wetland (in acres)
- the total area of the watershed for direct surface runoff (in acres)
- the watershed NRCS curve number

Then select .

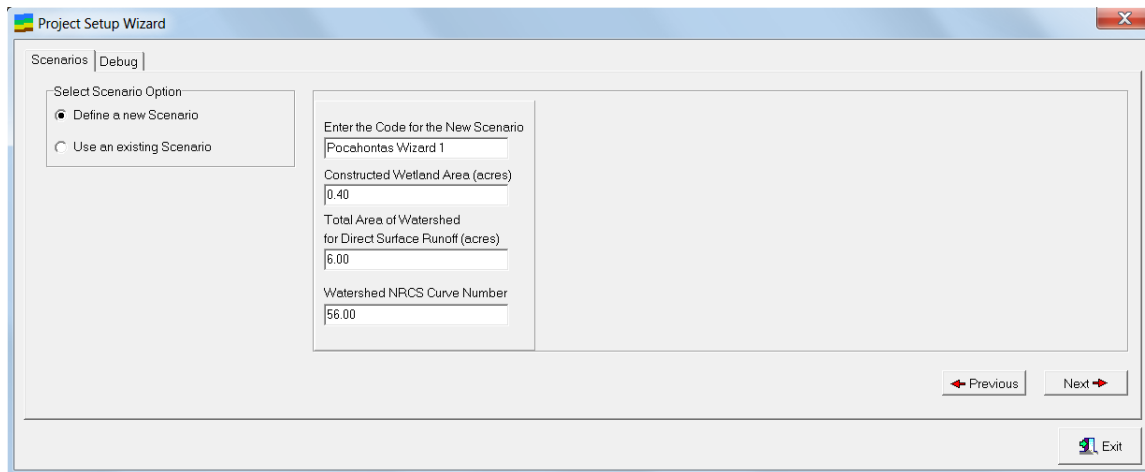
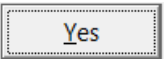
The image shows a 'Project Setup Wizard' window with a 'Scenarios' tab. On the left, under 'Select Scenario Option', the 'Define a new Scenario' radio button is selected. On the right, there are three input fields: 'Enter the Code for the New Scenario' with the text 'Pocahontas Wizard 1', 'Constructed Wetland Area (acres)' with the value '0.40', and 'Total Area of Watershed for Direct Surface Runoff (acres)' with the value '6.00'. Below these is a label 'Watershed NRCS Curve Number' with a value of '56.00'. At the bottom right, there are 'Previous' and 'Next' buttons, and an 'Exit' button with a small icon.

Figure 10. Wetbud Project Wizard: Define a new Scenario.

The message in Figure 11 will appear. Select  to proceed to the screen shown in Figure 12, which summarizes the water inputs, outputs, and water management.

Note: The Project Wizard will let you create a Project, even if not all of the required data are in place. However, errors will occur when the user tries to run the Project without ensuring that all input data is in place.

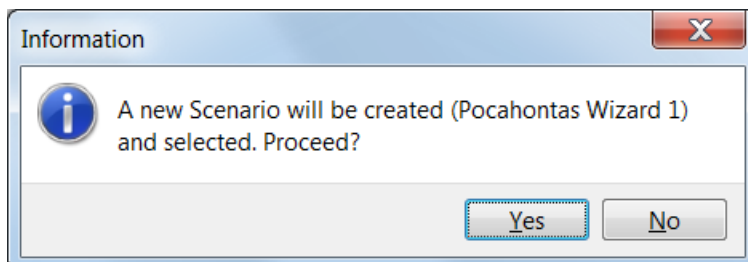
The image shows an 'Information' dialog box with a blue header and a red close button. It contains an information icon (a lowercase 'i' in a circle) and the text: 'A new Scenario will be created (Pocahontas Wizard 1) and selected. Proceed?'. At the bottom, there are two buttons: 'Yes' and 'No'.

Figure 11. Wetbud Project Wizard: Creating a new Scenario.

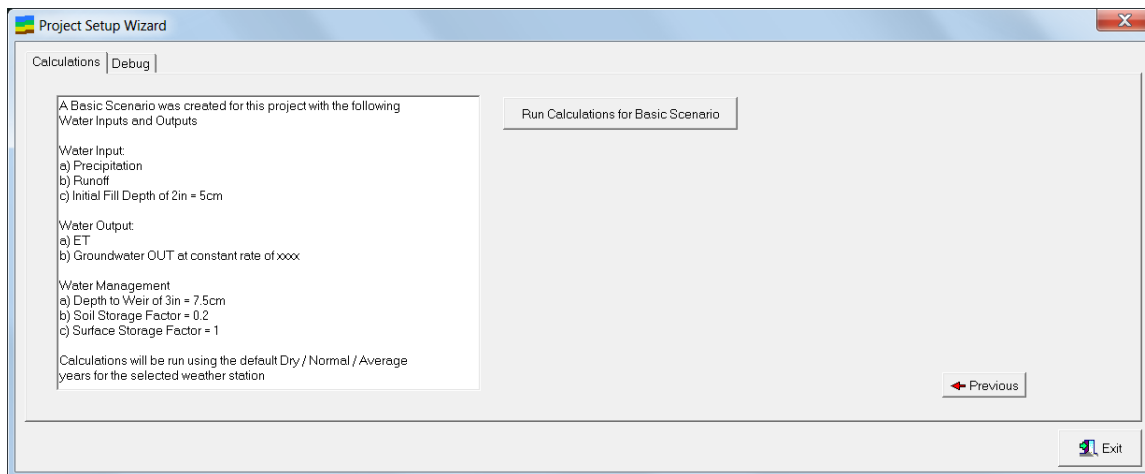
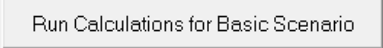


Figure 12. Wetbud Project Wizard: Basic Scenario creation.

Choose , and the Basic Scenario Analysis screen (Figure 13) will appear.

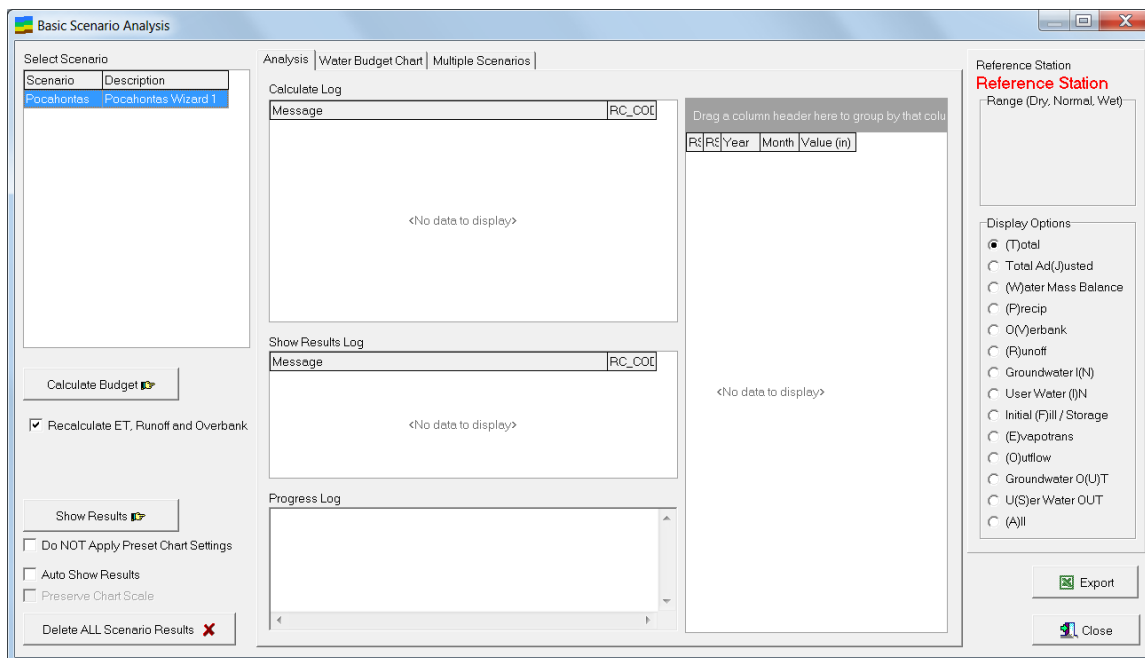



Figure 13. Basic Scenario Analysis screen with highlighted Scenario.

Basic Scenario Water Budget Analysis

1. To complete a Basic Scenario water budget analysis, highlight a Scenario, and click  (Figure 13). If adjustments are made to any parameters that may affect ET and/or runoff calculation (e.g. PET option, Curve Number, etc.), the user must check the box next to *Recalculate ET, Runoff, and Overbank* before recalculating the water budget for a water budget previously calculated within that Scenario.
2. The *Analysis* tab will then display a calculation log, a results log, a progress log, and a table of monthly results for the year. Wetbud will then display the options selected in the *Range* and *Display Options* boxes on the right side of the window, respectively (Figure 14).

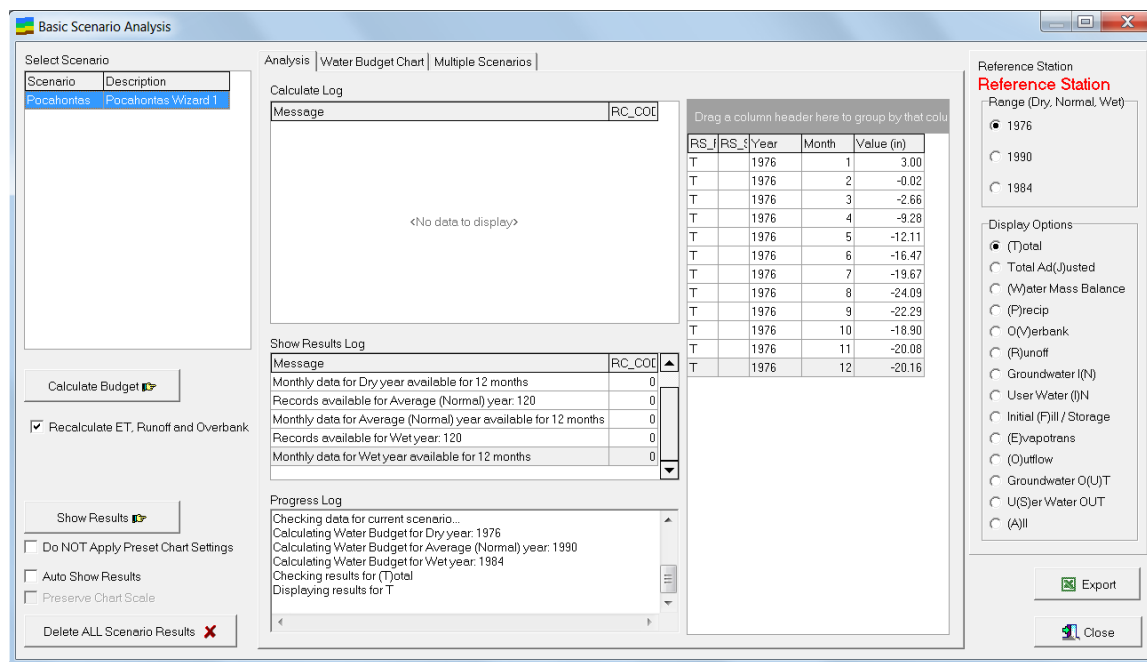


Figure 14. Basic Scenario Analysis: Calculation log, a results log, a progress log, and a table of monthly results for a dry year.

3. The *Calculate Log* will remain blank if all water budget calculations are successful.

4. The *Results Log* displays the number of records available for each year included in the water budget calculations.
5. The *Progress Log* displays messages regarding the progress of model calculations.
6. The table to the right of the “Calculate Log” panel displays monthly results for the year and variable selected in the *Range* and *Display Options* boxes on the right side of the *Basic Analysis* window. The user can view tabulated results for each variable in the water budget analysis by adjusting the selection in the *Display Options* box.
7. The *Water Budget Chart* tab (Figures 15 and 16) shows a graphical display of the *Basic* results. The user can choose to display each variable individually or combine all water budget components on the same graph by changing the selection in the *Display Options* box. The first two variables in the *Display Options* box, *(T)otal* (Figure 15) and *Total Ad(J)usted* are displayed as a line graph. *(T)otal* values are the total monthly mass balance water levels. *Total Ad(J)usted* values are water levels relative to the ground surface; these values represent the monthly water surface or water table elevation within the wetland. All other variables are displayed as a bar graph (Figure 16). Each year in the standard analysis range can be displayed by changing the selection in the *Range (Dry, Normal, Wet)* box.

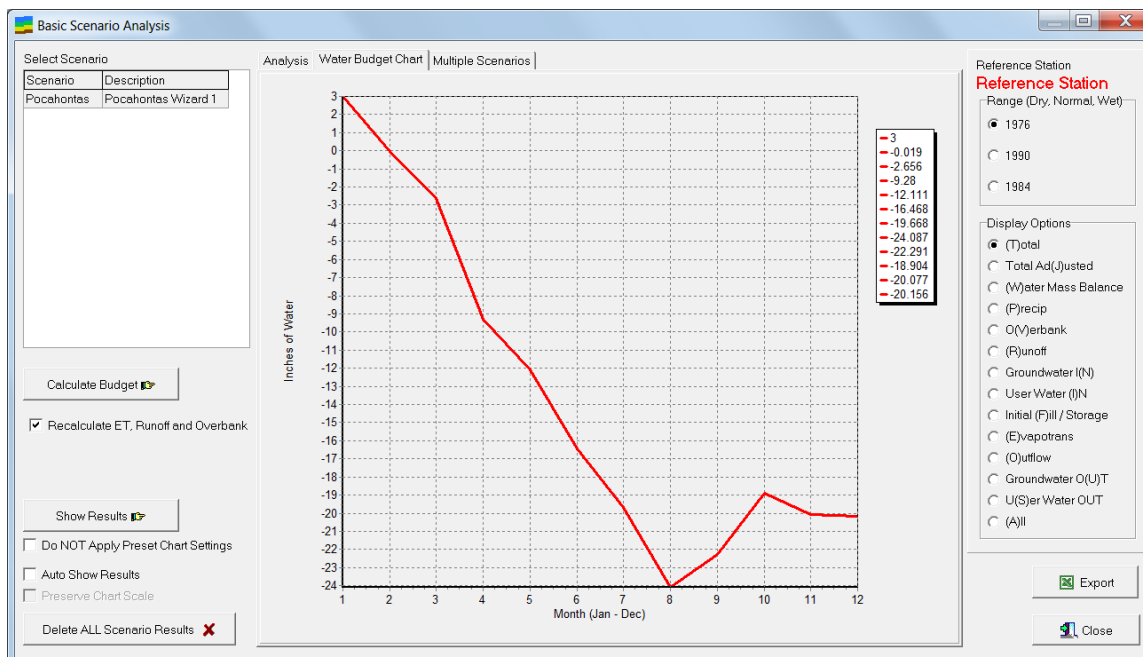


Figure 15. Basic Scenario Analysis: Water Budget Chart (Total) for a dry year.

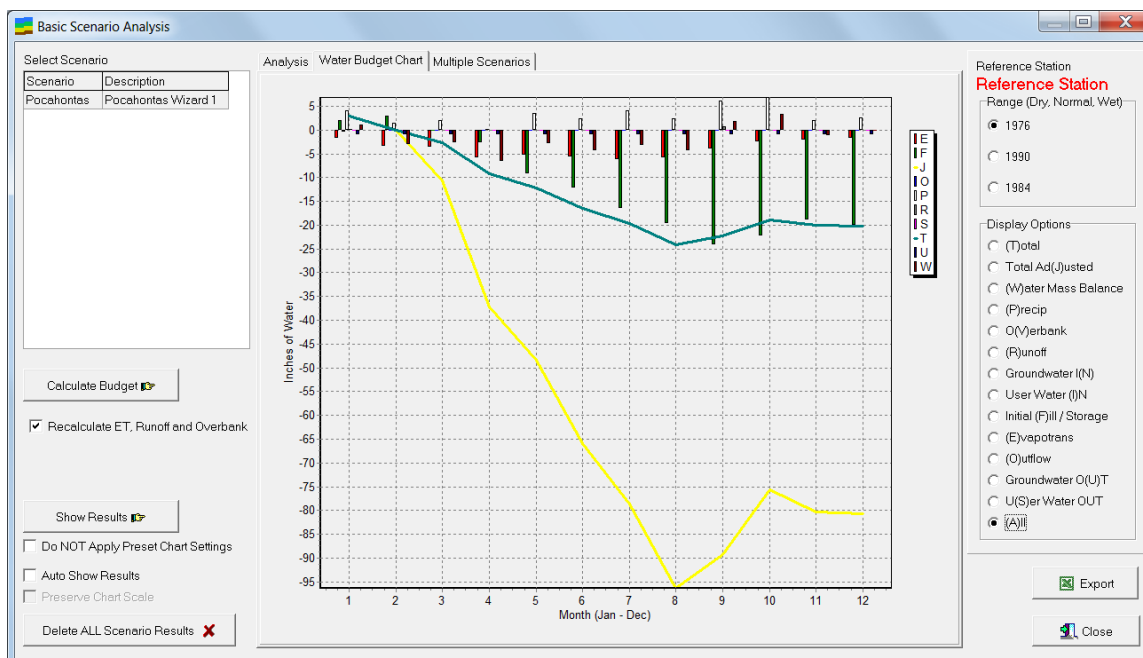

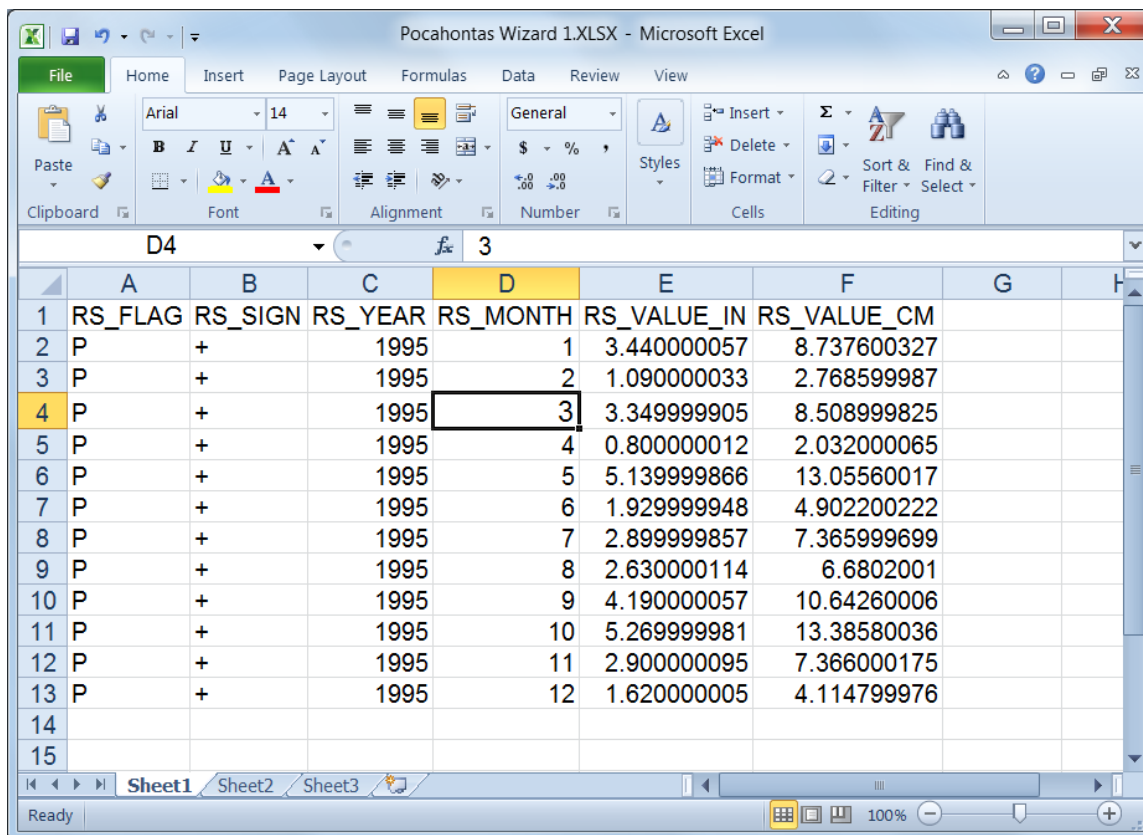


Figure 16. Basic Scenario Analysis: Water Budget Chart (All) for a dry year.

Exporting Basic Model Water Budget Results


Basic Model includes all inputs and outputs displayed in the *Basic Analysis* window. To export results for an individual variable, select the variable in the *Display Options* box and click  Export. For example, the Excel file in Figure 17 shows results for the variable “Precipitation” during a dry year. Note that variables are denoted in the exported Excel file by the letter in parentheses in the *Display Options* box. For example, (P) recipitation = P in the column “RS_FLAG” in an exported Excel data file. (RS=Reference Site).

Name and save the exported file in the prompt that appear, and place on the desktop or in the MyWetbud folder under Documents.



	A	B	C	D	E	F	G	H
1	RS_FLAG	RS_SIGN	RS_YEAR	RS_MONTH	RS_VALUE_IN	RS_VALUE_CM		
2	P	+	1995	1	3.440000057	8.737600327		
3	P	+	1995	2	1.090000033	2.768599987		
4	P	+	1995	3	3.349999905	8.508999825		
5	P	+	1995	4	0.800000012	2.032000065		
6	P	+	1995	5	5.139999866	13.05560017		
7	P	+	1995	6	1.929999948	4.902200222		
8	P	+	1995	7	2.899999857	7.365999699		
9	P	+	1995	8	2.630000114	6.6802001		
10	P	+	1995	9	4.190000057	10.64260006		
11	P	+	1995	10	5.269999981	13.38580036		
12	P	+	1995	11	2.900000095	7.366000175		
13	P	+	1995	12	1.620000005	4.114799976		
14								
15								

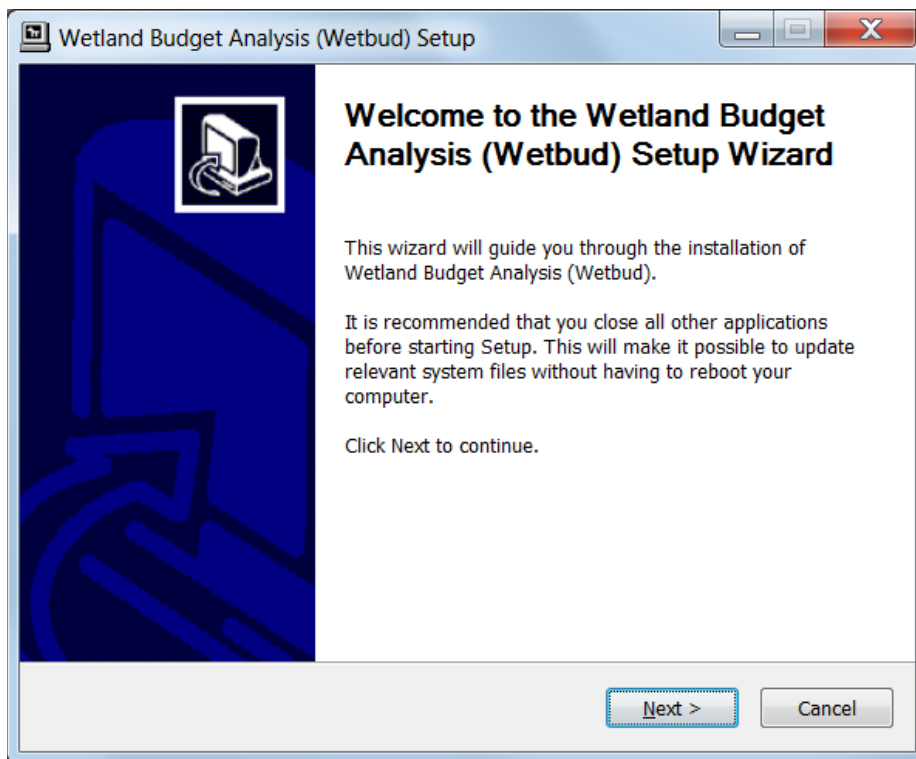
Figure 17. Exported Excel file showing precipitation data for a dry year.

To export results for all variables in the *Display Options* box, select *(A)ll* in the *Display Options* box and click  Export. Name and save the exported file in the prompt that appears.

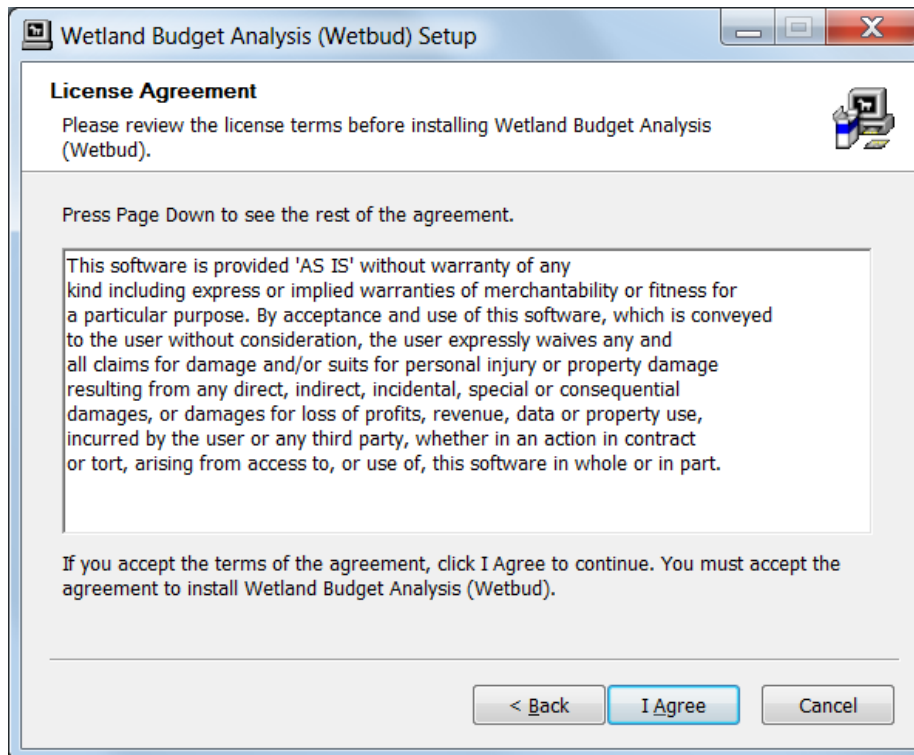
Appendix A. Wetbud Plus Installation Instructions

The following applies to an installation where Wetbud is installed as a downloaded file, and the database and the executable files will reside on the same computer.

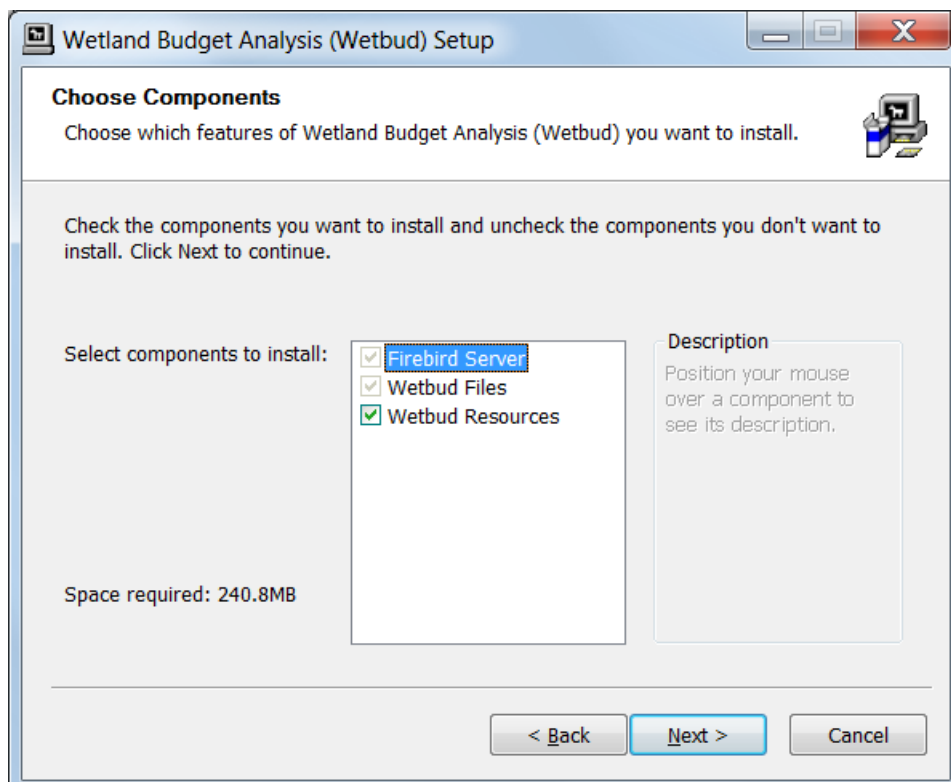
1. Open the link provided and select *Download*, then select *Save File*. Wetbud will download to your computer. Open the download. The Welcome to the Wetland Budget Analysis (Wetbud) Setup Wizard screen will appear (pictured below). Select *Next*.



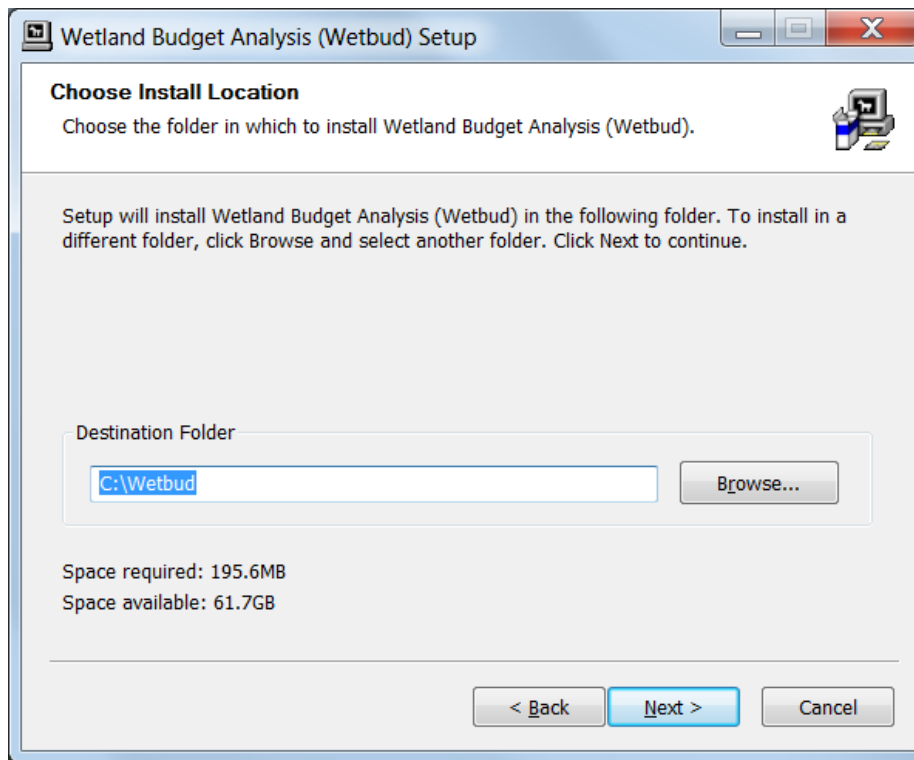
2. The *License Agreement* screen will appear (pictured below). Select *I agree*.



3. The *Choose Components* screen will appear (pictured below). *Firebird Server* and *Wetbud Files* are mandatory and *Wetbud Resources* (user's manuals and associated help files) is optional. Click *Next*.

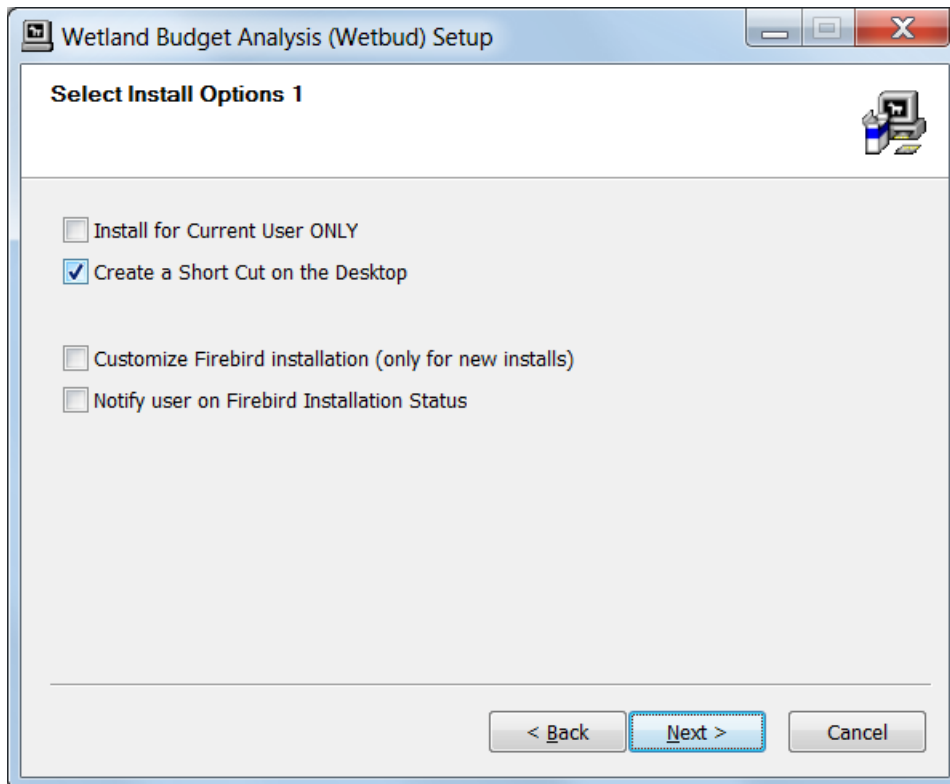


4. The *Choose Install Location* screen will appear (pictured below). Wetbud will install into C:\Wetbud as the default location. Select *Next*.

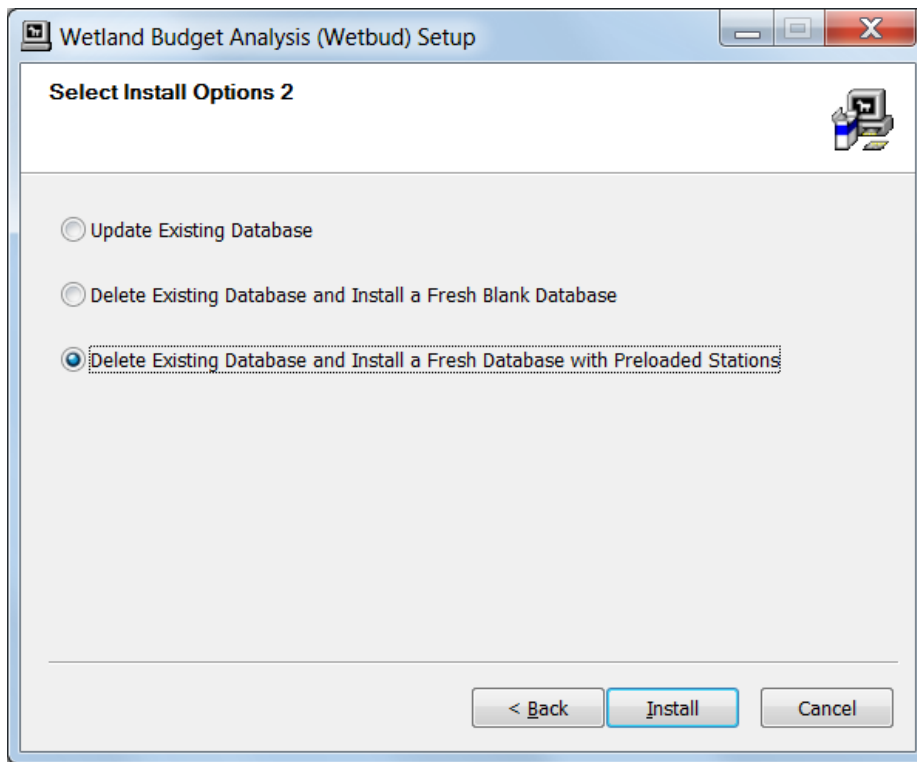


5. The Select Install Options 1 screen will appear (pictured below). Note that Wetbud stores all associated data in a Firebird database (Firebird is open source software available in the public domain), so the Firebird database software will be installed along with Wetbud.

Choose your preferred options for installation. “Customize Firebird installation” will allow you to choose your preferred folder for the Firebird software, while “Notify User on Firebird Installation Status” will inform you of the progress of the Firebird software installation. Then select *Next*.



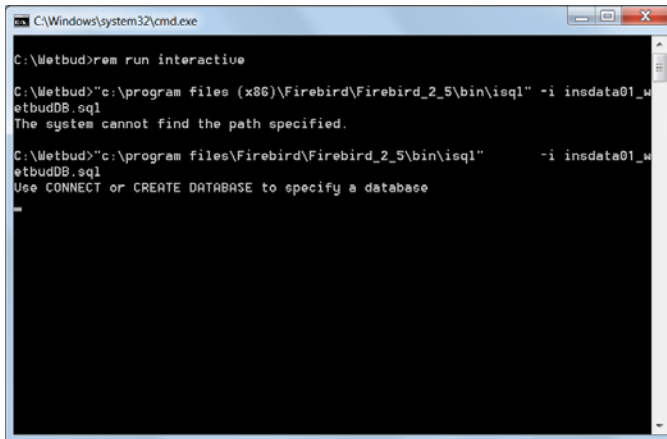
6. If there is an existing installation of Wetbud on your computer, the Select Install Options 2 screen will appear (pictured below). If you wish to install Wetbud Plus with preloaded weather stations, choose *“Delete Existing Database and Install a Fresh Database with Preloaded Stations”*.



7. Wetbud will then begin installing (1) the Firebird database software and (2) the Wetbud software on your computer.

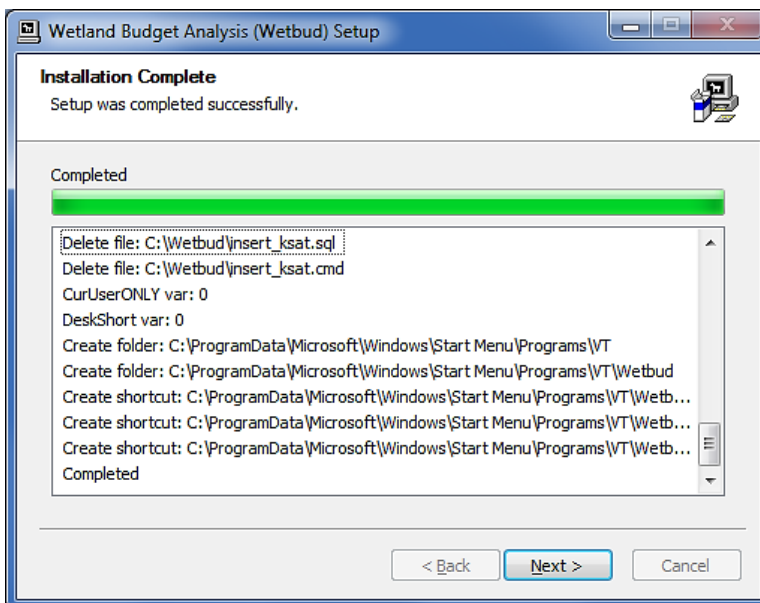
Note that if Wetbud is re-installed on a system, the installation script will automatically create a backup copy of the existing database and place it in a dated folder within C:\Wetbud. Therefore, an existing database cannot be accidentally overwritten during reinstallation.

8. As the Wetbud installation proceeds, multiple DOS screens (see example below) will appear, but will close automatically after a short time. Please be patient.

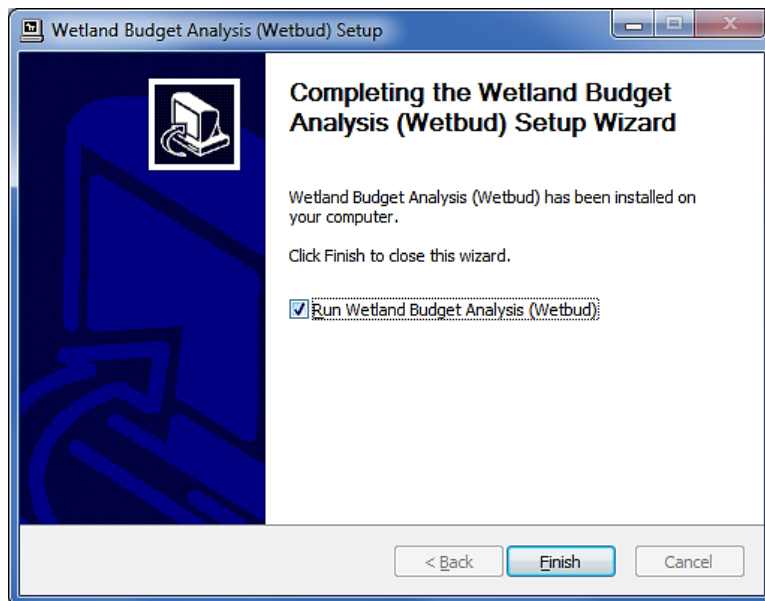


```
C:\Windows\system32\cmd.exe
C:\Wetbud>rem run interactive
C:\Wetbud>"c:\program files (x86)\Firebird\Firebird_2_5\bin\isql" -i insdata01_wetbudDB.sql
The system cannot find the path specified.
C:\Wetbud>"c:\program files\Firebird\Firebird_2_5\bin\isql" -i insdata01_wetbudDB.sql
Use CONNECT or CREATE DATABASE to specify a database
```

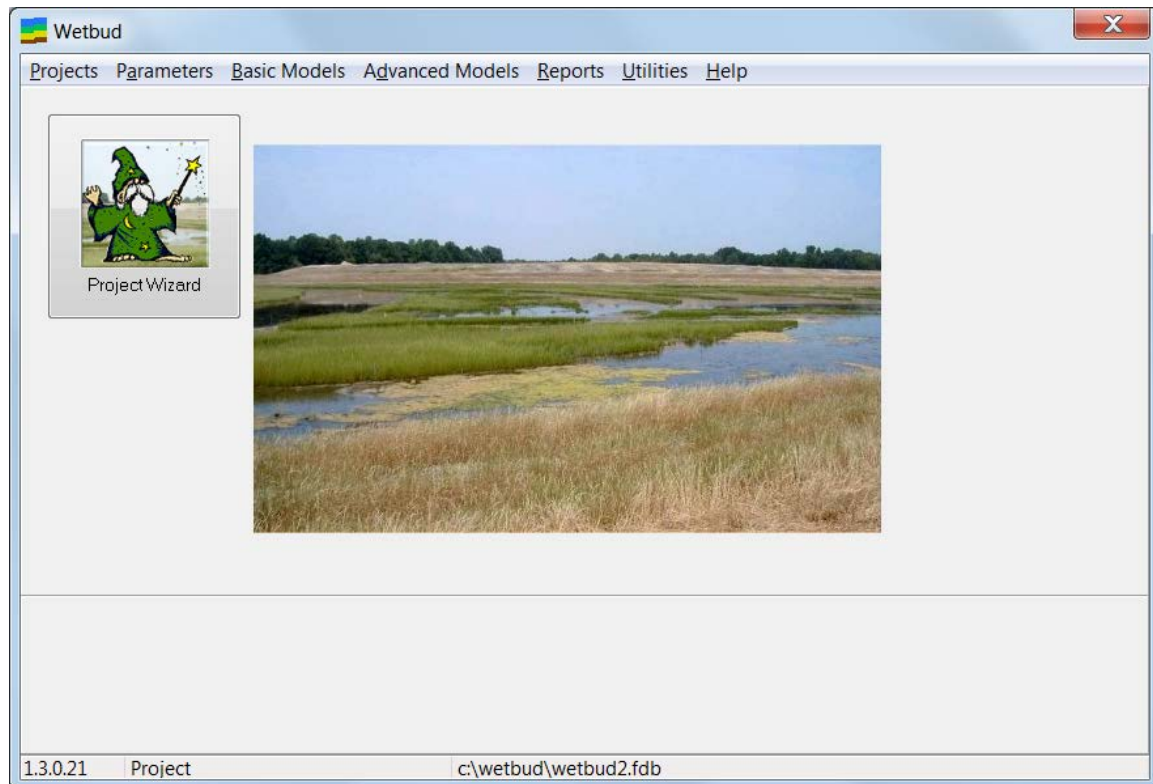
9. When installation is concluded, the *Installation Complete* screen will then appear (pictured below). Select *Next*.



10. The *Completing the Wetland Budget Analysis (Wetbud) Setup Wizard* screen will appear (pictured below). Select *Finish*.



11. If *Run Wetland Budget Analysis (Wetbud)* is checked, the Wetbud home screen (below) will open.



Appendix B. Datasets for the 14 Preloaded Weather Stations

The Wetbud software requires complete datasets to function properly. To create the 14 preloaded weather stations for the Wetbud Plus Project Wizard, weather datasets such as precipitation, weather, and solar were downloaded and imported for each selected station. Once the data was downloaded and imported, it was discovered that a few data values were missing from the datasets. Missing data was filled from nearby stations with similar attributes. Nearby GSOD stations were used to fill in missing weather and solar data. Solar data not filled by GSOD stations was retrieved from the National Solar Radiation Data Base (NRSDB) website.